

WHAT IS CLAIMED IS:

1. A powder material comprising a compound which electrochemically intercalates and deintercalates a lithium ion, wherein the powder material is comprised
5 of a compound as a main material, which compound contains at least an oxygen element, a sulfur element and at least one transition metal element.
2. The powder material according to Claim 1,
10 wherein a content ratio of the oxygen element to the sulfur element in the powder material is 0.1 to 100 in terms of an elementary molar ratio, and an elementary molar ratio of (the oxygen element + the sulfur
15 element) to the transition metal element is 1.0 to 4.0.
3. The powder material according to Claim 2,
wherein a content ratio of the oxygen element to the sulfur element in the powder material is 0.5 to 50 in
20 terms of an elementary molar ratio.
4. The powder material according to Claim 2,
wherein a content ratio of (the oxygen element + the sulfur element) to the transition metal element in the
25 powder material is 1.0 to 3.0 in terms of an elementary molar ratio.
5. The powder material according to Claim 1,

wherein the powder material is comprised of particles having a mean particle diameter of 0.05 to 100 μm .

5 6. The powder material according to Claim 5, wherein the powder material is comprised of particles having an mean particle diameter of 0.1 to 50 μm .

10 7. The powder material according to Claim 1, wherein the powder material is powder having a specific surface area of 1.0 to 500 m^2/g .

15 8. The powder material according to Claim 7, wherein the powder material is powder having a specific surface area of 2.0 to 300 m^2/g .

9. The powder material according to Claim 1, wherein the powder material contains a lithium element.

20 10. A process for preparing a powder material comprised mainly of a compound which electrochemically intercalates and deintercalates a lithium ion and contains at least an oxygen element, a sulfur element and at least one transition metal element, the process comprising at least one step selected from a group
25 consisting of:

1) a step of heating at least one compound (a) selected from a group consisting of carbonates, organic

carboxylates, nitrates, hydroxides and oxides of transition metals, and a sulfur compound (b) which forms hydrogen sulfide or sulfur, in a closed vessel;

II) the step of heating at least one compound (c)
5 selected from a group consisting of sulfides, thiocarbonates, thiosulfates, thiocyanates, thioglicolates and thiourea complexes of transition metals and at least one compound (d) selected from a group consisting of carbonates, carbonic acid, organic
10 carboxylates, organic carboxylic acids, nitrates, nitric acid, hydroxides and oxides, which contains no transition metal element, in a closed vessel; and

III) the step of heating at least one compound (a) selected from a group consisting of carbonates, organic
15 carboxylates, nitrates, hydroxides and oxides of transition metals and at least one compound (c) selected from a group consisting of sulfides, thiocarbonates, thiosulfates, thiocyanates, thioglicolates and thiourea complexes of transition
20 metals in a closed vessel.

11. The process according to Claim 10, wherein in each of the steps (I) to (III), a compound containing at least a lithium element is added to any of the
25 respective compounds, followed by heating the resultant mixture in the closed vessel.

12. The process according to Claim 11, wherein at least one compound selected from a group consisting of lithium hydroxide, lithium oxide and lithium sulfide is used as the compound containing at least a lithium
5 element in each of the steps (I) to (III).

13. The process according to Claim 10, which comprises the step of mixing the compounds to be used by means of physical energy prior to the step (I), (II)
10 or (III).

14. The process according to Claim 13, wherein the step of mixing the compounds to be used is a step of grinding and mixing them by means of a grinding
15 machines.

15. The process according to Claim 10, wherein the heating in the closed vessel in each of the steps (I) to (III) is conducted under a pressure of 1.0 to 300
20 kg/cm².

16. The process according to Claim 15, wherein the heating under pressure is conducted under a pressure of 2 to 200 kg/cm².
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17. The process according to Claim 10, wherein the heating in the closed vessel in each of the steps (I)

to (III) is conducted at 100 to 800°C.

18. The process according to Claim 17, wherein the heating in the closed vessel is conducted at 130 to
5 400°C.

19. The process according to Claim 10, wherein the heating in the closed vessel is a step of heating the respective compounds in a solvent.
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20. The process according to Claim 19, wherein the solvent is water.

21. The process according to Claim 10, wherein the
15 heating in the closed vessel is a step of heating the respective compounds in an atmosphere comprised of at least one kind of gas selected from a group consisting of nitrogen, oxygen, air, sulfur dioxide, sulfur monoxide, hydrogen sulfide, and inert gases such as
20 argon and helium.

22. The process according to Claim 10, wherein the compound (b) which forms hydrogen sulfide or sulfur is a compound which forms hydrogen sulfide or sulfur upon
25 heating.

23. The process according to Claim 22, wherein the

compound (b) which forms hydrogen sulfide or sulfur is at least one compound selected from a group consisting of thioamides, thiocarbonic acid and derivatives thereof, and thiosulfuric acid and derivatives thereof.

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24. The process according to Claim 10, wherein the compound (b) which forms hydrogen sulfide or sulfur is an alkali metal sulfide.

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25. The process according to Claim 24, wherein the alkali metal sulfide is lithium sulfide.

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26. The process according to Claim 10, wherein the compound (a) is at least one compound selected from a group consisting of hydroxides and oxides of transition metals.

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27. The process according to Claim 10, wherein the compound (c) is at least one compound selected from a group consisting of sulfides, thiocarbonates and thiosulfates of transition metals

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28. The process according to Claim 10, wherein the compound (d) is at least one compound selected from a group consisting of hydroxides and oxides, which contains no transition metal element.

29. The process according to Claim 28, wherein the compound (d) is lithium hydroxide.

30. An electrode structure for a battery utilizing
5 the intercalation and deintercalation reaction of a lithium ion, the structure comprising the powder material according to any one of Claims 1 through 9 as a main component.

10 31. A process for producing an electrode structure for a battery utilizing the intercalation and deintercalation reaction of a lithium ion, the process comprising the steps of preparing a powder material which electrochemically intercalates and deintercalates
15 a lithium ion and contains at least an oxygen element, a sulfur element and at least one transition metal element; and molding the powder material to obtain an electrode structure.

20 32. A process for producing an electrode structure for a battery utilizing the intercalation and deintercalation reaction of a lithium ion, the process comprising the steps of preparing a powder material, which electrochemically intercalates and deintercalates
25 a lithium ion and contains at least an oxygen element, a sulfur element and at least one transition metal element, in accordance with the preparation process

according to any one of Claims 10 through 29; and
molding the powder material to obtain an electrode
structure.

- 5 33. A secondary lithium battery fabricated from at
least a negative electrode, a positive electrode, an
electrolyte and a battery case and utilizing the
intercalation and deintercalation reaction of a lithium
ion for charging and discharging, wherein the negative
10 electrode and/or the positive electrode is comprised of
an electrode structure comprising, as a main component,
the powder material according to any one of Claims 1
through 9, which electrochemically intercalates and
deintercalates a lithium ion and contains at least an
15 oxygen element, a sulfur element and at least one
transition metal element.